Comparison of MOD04 and CALIPSO Cloud Mask and its Implications on MOD04 Aerosol Product

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Introduction

Aerosols are important components of the atmosphere which can significantly affect the radiative transfer and cloud processes in the climate system.

A reliable retrieval of aerosol amount from satellite data requires accurate cloud mask information.

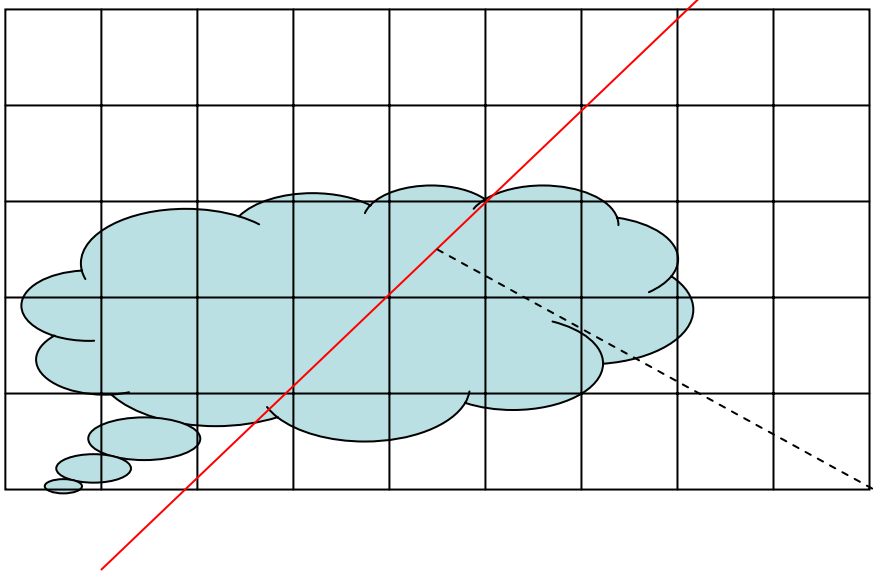
The cloud mask data from passive measurements need to be validated by other means.

The aerosol cloud mask from MODIS (MOD04) is compared with the cloud mask from a space-borne lidar (CALIPSO) measurements.

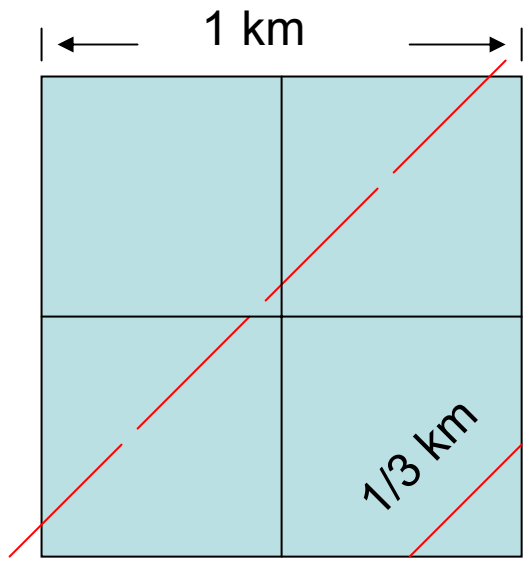
Algorithm

MODIS Swath

CALIOP TRACK



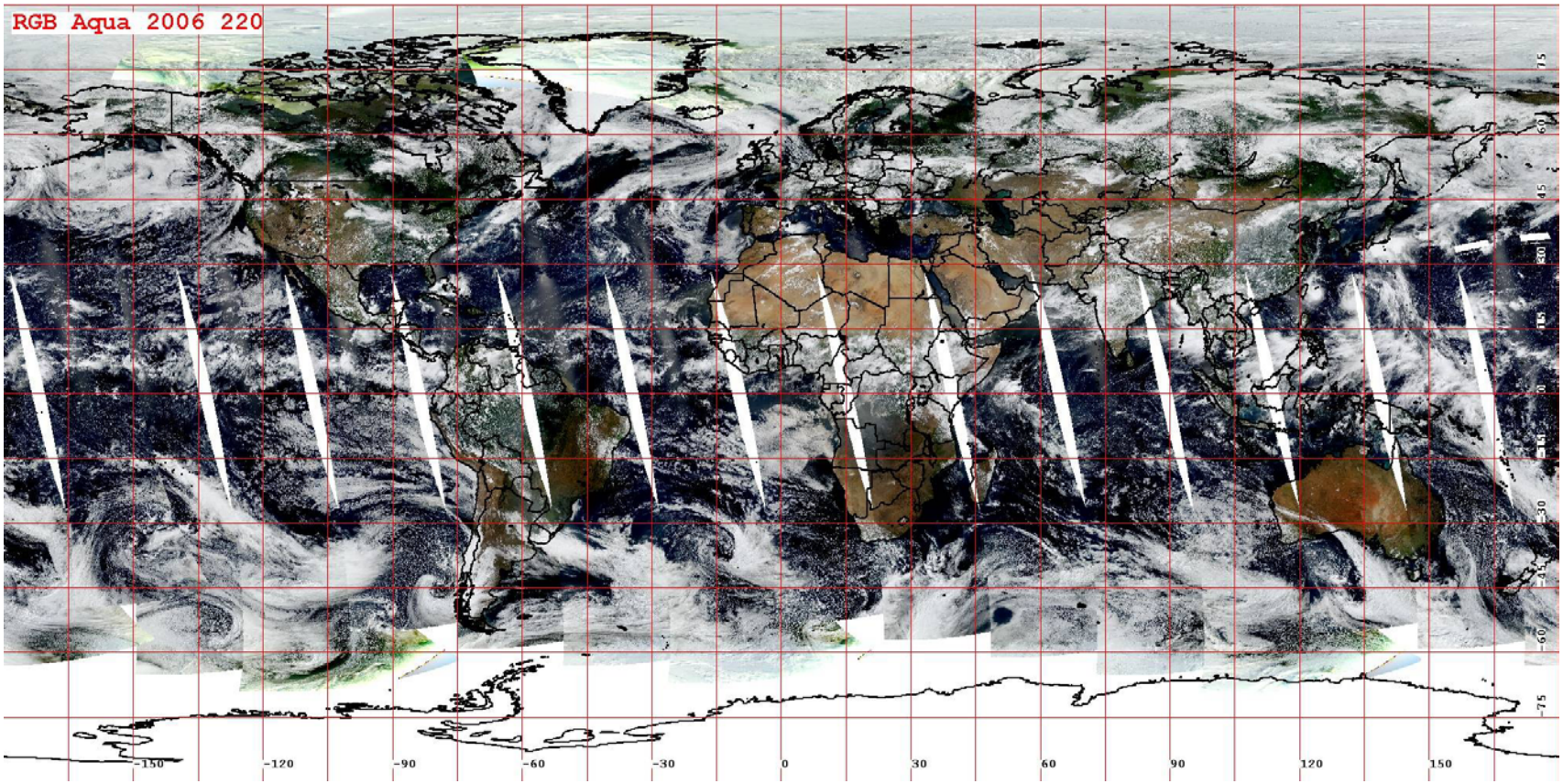
A 1km x 1km area can have up to 4 CALIOP shots of 1/3km long.



CALIOP Level 2 Cloud Product and MOD04 Aerosol Cloud Mask data are collocated on 1km x 1km box along the CALIPSO track.
MOD04: 500m x 500m data 2D average
CALIOP: 1/3, 1, 5 (20, 80) km data 1D average

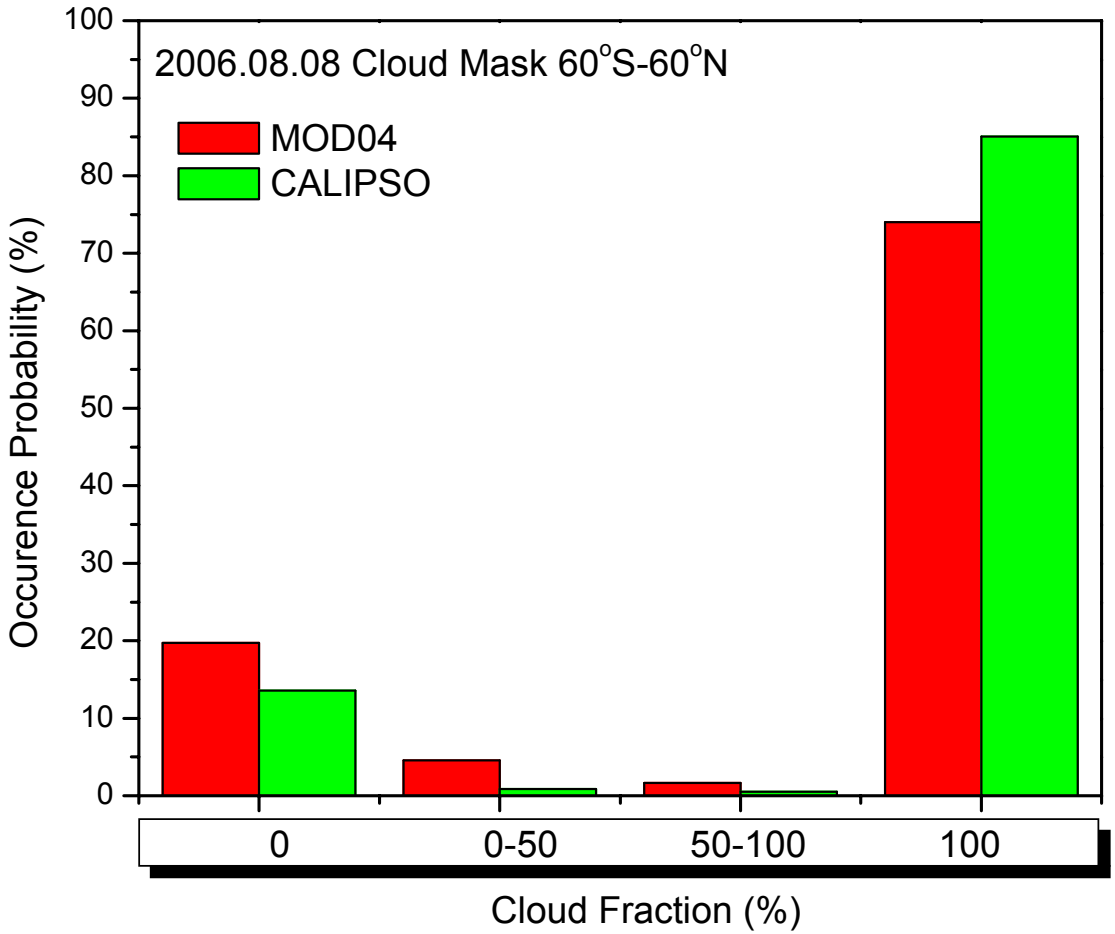
Data

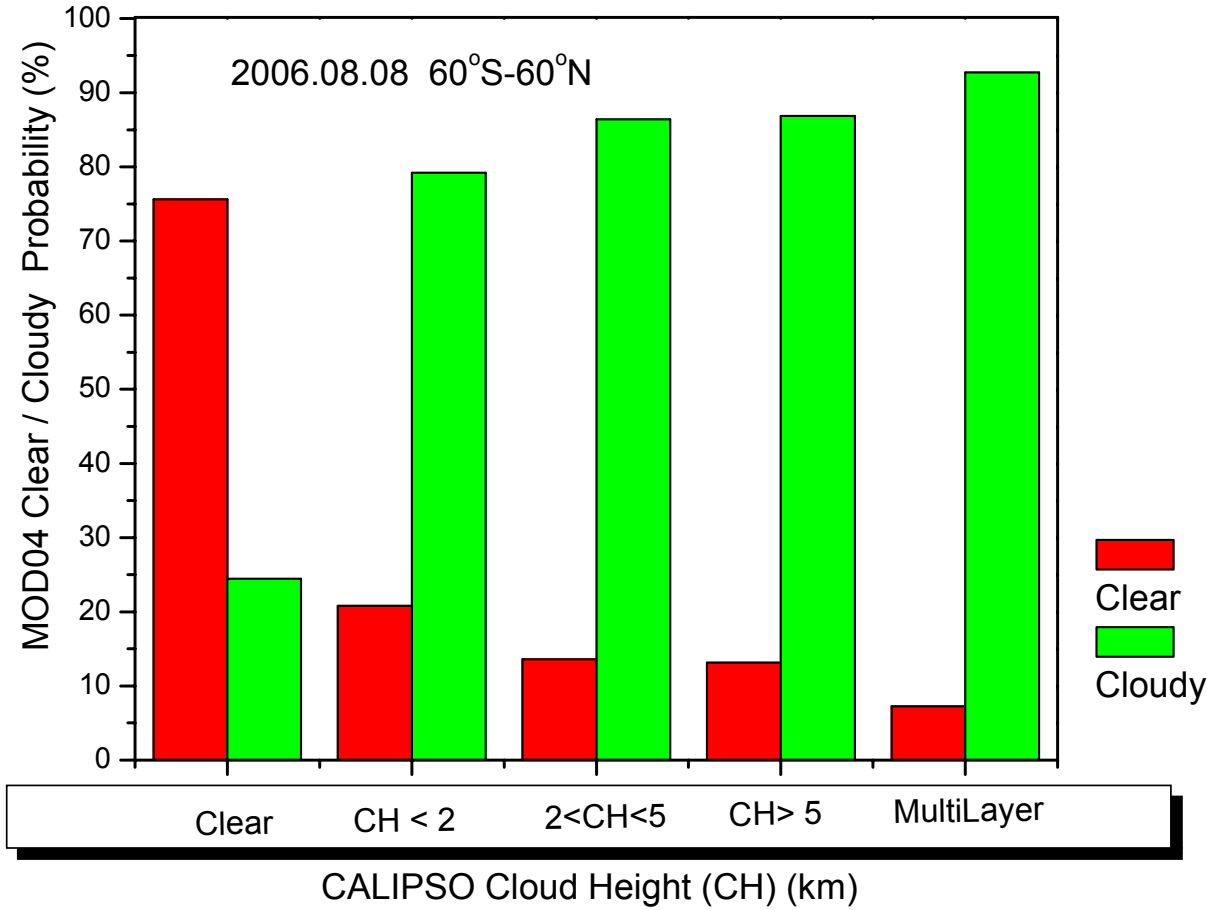
The cloud masks from Aqua MOD04 and CALIPSO for 15 orbits of data on August 8, 2006.

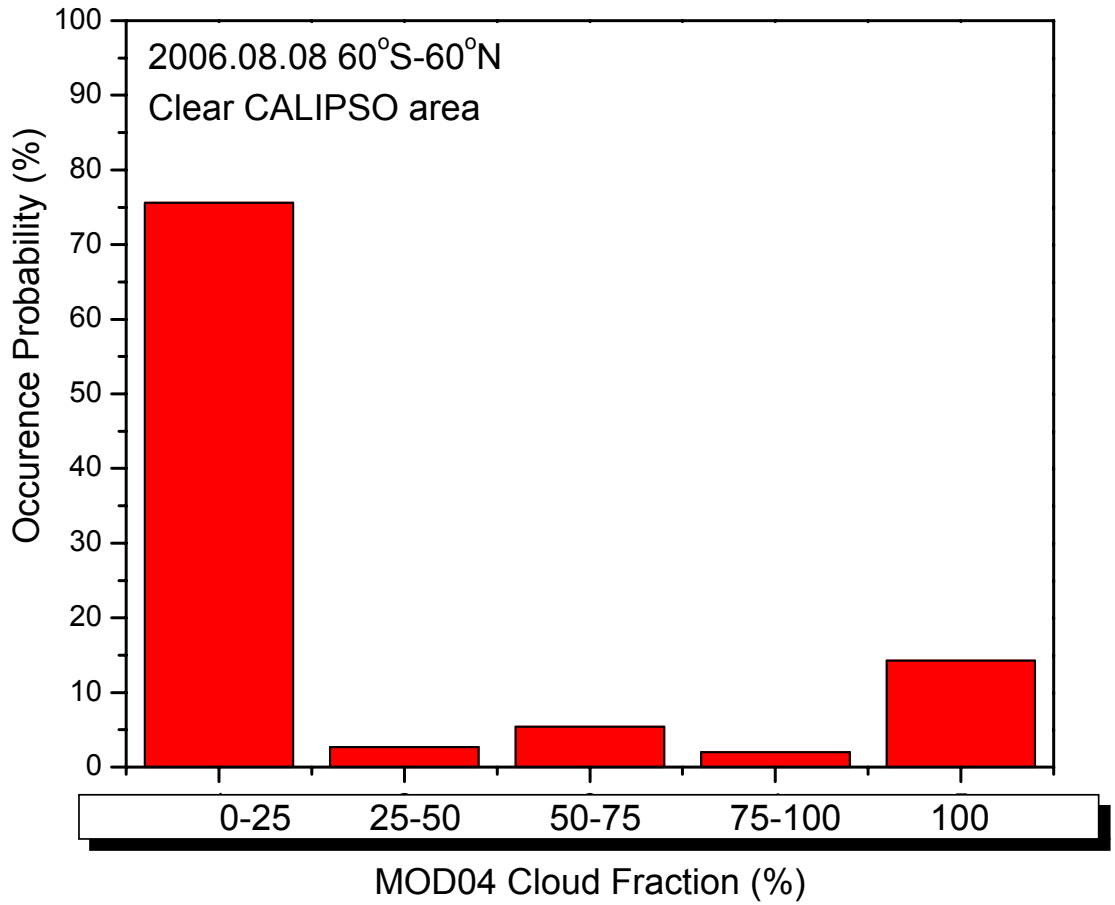


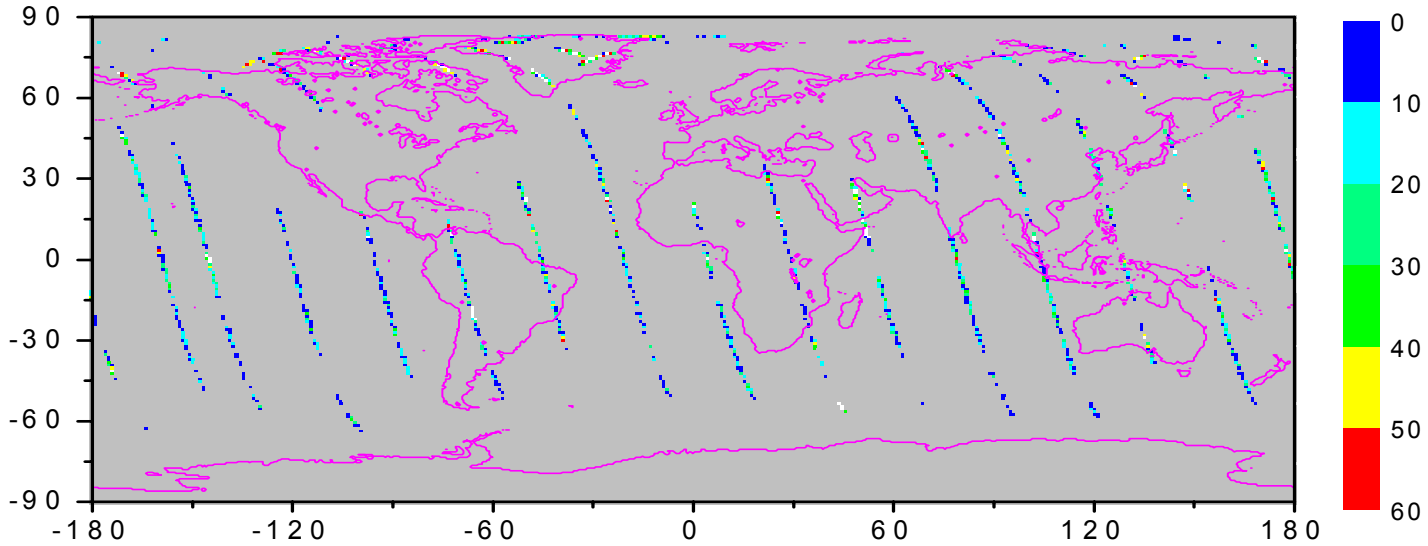
Global RGB picture from Aqua for August 8, 2006

Results


2006.08.08 Cloud Mask 60°S-60°N
MOD04
CALIPSO
Occurence Probability (%)
100
90
80
70
60
50
40
30
20
10
0
0
0-50
50-100
100
Cloud Fraction (%)


2006.08.08 60°S-60°N
MOD04 Clear / Cloudy Probability (%)
100
90
80
70
60
50
40
30
20
10
0
Clear
Cloudy
Clear
CH < 2
2<CH<5
CH> 5
MultiLayer
CALIPSO Cloud Height (CH) (km)


2006.08.08 60°S-60°N
Clear CALIPSO area
Occurence Probability (%)
100
90
80
70
60
50
40
30
20
10
0
0-25
25-50
50-75
75-100
100
MOD04 Cloud Fraction (%)



Global distribution of 1km x 1km area number with mismatched cloud masks between MOD04 and CALIPSO

Statistics of matched and mismatched cases

		CALIPSO Cloud Fraction Bins			
		0.0	0.0-0.5	0.5-1.0	1.0
MOD04 Cloud Fraction Bins	0.0	14.79%	0.23%	0.36%	4.34%
	0.0-0.5	0.65%	0.03%	0.05%	0.56%
	0.5-1.0	1.91%	0.15%	0.23%	2.63%
	1.0	3.77%	0.39%	0.72%	69.11%

Total 1km x 1km region number: 219897

Conclusions

1. CALIPSO detects more clouds than MOD04.

2. ~25% of clear-sky scenes are identified by MOD04 as cloudy cases.

3. ~8-22% of cloudy scenes from CALIPSO are identified by MOD04 as clear cases, which reveals a significant percentage of error in the MOD04 aerosol product.

4. Movement of the clouds during the period between MODIS and CALIOP measurements explains some mismatch of the scene types?